pattern from the embossing tool to the green tape, [and]

screen printing a suitable ink into the channels or openings so the ink does not extend above the surface of said green tape, [to a desired thickness.]

burying said green tape with one or more green tape layers to form a green tape stack, and

firing said stack.

REMARKS

The present invention is directed to increasing the resistance in transmission lines, and most importantly, to reducing the loss of definition, or distortion, of transmission lines.

Attempts in the past to reduce resistance in transmission lines focussed on increasing the conductivity of the lines, usually by increasing the thickness of the transmission lines. However, when heat and pressure are applied to green tape stacks, such lines become distorted, with a loss of line definition and a change in shape. This affects performance, particularly for operation at 8.4-12.44 GHz frequencies. Such distortion results in insertion and reflection losses and low Q values, as disclossed in the present specification on page 4.

By embossing lines and openings in green tape, filling them by screen printing as required by the claims, i.e., by filling them only to the top of the planar surface of the green tape, and then firing, such distortion does not occur because the conductive lines are protected by the sidewalls of the embossed details, and they do not extend above the surface of the green tape.

Proposed amendments to further clarify the present process are made above.

Claims 1-3 have been rejected over the IBM reference in view of Amendola et al. This rejection is respectfully traversed.

IBM does not address the present problem, of forming low resistance transmission lines so as to reduce their distortion during the lamination and firing steps at all. In fact, IBM addresses a very different problem for high speed circuits, i.e., maintaining an insulation dielectric constant between conductive lines at a level of 2-4.

The method of IBM is also very different from the method claimed. Recesses are formed in a green tape by "E-beam cutting or mechanical stamping", which does not suggest lamination that requires heat and pressure, and filled by screen printing. This

step is followed by forming additional recesses adjacent to the filled areas which are filled with a filler paste to form air pockets when successive green tapes are stacked, laminated and fired. There is no requirement that the material used to fill the stamped recesses not extend above the surface of the green tape, nor any disclosure of burying the green tape, as required by the amended claims. Thus applicants submit there is no suggestion or disclosure in the reference seeking to reduce distortion. In fact, using the IBM method, the surface of the green tape is deliberately distorted by forming discrete air pockets, a result not desired by applicants at all. Thus applicants submit there is no reason to use this reference except in the light of hindsight, which is improper. Still further, as the Examiner concedes, IBM does not disclose the use of heat and pressure during the stamping step.

Thus the Examiner has combined IBM with Amendola et al. However, this reference forms grooves on a ceramic substrate, not on a green tape. Amendola et al fills grooves after firing the green tape. For present purposes, while he may not distort lines after filling grooves, the unfilled grooves themselves are distorted during the firing step. Thus even if Amendola et al is

combined with IBM, the present method, which requires embossing, filling and firing, is not disclosed.

Further, applicants submit the Examiner is combining those portions of the steps disclosed in these references by selecting only those portions which fit the present sequence of steps, which is submitted to be based entirely on hindsight based on the present disclosure, which, again, is improper.

Applicants' claim 3 requires an ink viscosity of about 30 poise. As applicants have disclosed in their specification in Table I and on page 10, the present inks have lower viscosity, of about 25-30, yet contain high amounts of conductive metal to maintain high conductivity and low resistivity. Standard inks have a viscosity of about 45 or higher. This is done by using a low viscosity resin mixture for the inks.

Ths inks used for filling embossed channels and openings has a low viscosity because they must flow readily into small grooves and openings. These inks are retained by the walls of the embossed lines and openings, and thus they do not depend on a thick viscosity to maintain print definition. Inks used to screen print patterns on the surface of green tapes on the other hand must have a higher viscosity in order to retain their shape

during the screening, lamination and firing steps. Thus the viscosity useful for the present application is not necessarily obvious, unless the utility is known in advance. The references do not disclose the present problem and solution at all.

Claims 4-7 have been rejected over IBM and Amendola et al further in view of Vitriol et al. These claims require various types of inks to make various types of devices, including resistors and capacitors. While it was known how to make these devices using green tape technology, the present method is considered to be patentable over the primary references, as explained above. Vitriol et al does not suggest embossing patterns in green tape, filling the patterns and then firing, as required by the present claims. Vitriol et al wants to shape the green tape itself, by bending and the like, prior to firing. Applicants concede that forming resistors and capacitors by using particular inks was known at the time the present invention was made. However, Vitriol et al does not suggest any of the present process steps at all.

Claims 9 and 10 require embossing an opening on the surface of green tape, filling the opening with a component ink, burying the green tape in a green tape stack, laminating and then firing

to make buried passive components. These claims have been rejected over the above references further in view of Prabhu. Prabhu is cited and discussed in applicants' specification. The reference does disclose that shrinkage in green tapes in the x and y dimensions can be greatly reduced when a green tape stack is mounted on a metal support board coated with a low melt temperature glass. However, the green tape still shrinks in the z dimension. In the present invention, z shrinkage is minimized in the embossed green tape because the openings are filled with a conductor ink containing high amounts of conductive metal before the firing step.

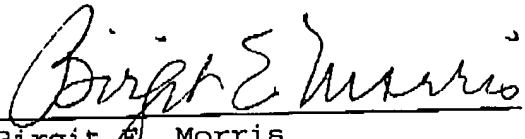
Applicants submit this result is not obvious unless the openings or grooves are first formed, and then filled, prior to firing. But as discussed above, this sequence of steps is not taught or suggested by the primary references, as conceded by the Examiner. However, the Examiner states the reference is used for its teaching of embossing at temperatures of 75-95°C and pressures of 500-3000 psi. This is not suggested by the reference as an embossing temperature, but as a lamination temperature. Applicants' claims 9 and 10 required first embossing, then filling the embossed openings, then burying the embossed and

filled green tape in a green tape stack, then mounting the stack onto a metal supported board, then laminating and finally firing. Applicants submit again this sequence of steps as claimed are patentable because they are neither suggested nor are they obvious over the references except in the light of hindsight.

Further, none of the references seek to solve the present problem as addressed by applicants, i.e., improved line definition for transmission lines.

In view of the above discussion, entry of the proposed amendments, and allowance of the amended claims are respectfully solicited.

Respectfully submitted,

By 
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CLEAN COPY OF THE AMENDED CLAIM

1. (Amended) a method of forming low resistance transmission lines and openings without distortion for buried passive components in green tapes comprising, in sequence,

embossing a channel or opening directly on the surface of a green tape using an embossing tool having a desired pattern thereon using heat and pressure sufficient to transfer the pattern from the embossing tool to the green tape,

screen printing a suitable ink into the channels or openings so the ink does not extend above the surface of said green tape,

burying said green tape with one or more green tape layers to form a green tape stack, and

firing said stack.